DER
DISTRIBUTED ENERGY RESOURCES

Advanced Generation:
Oil Combustion Equipment

Tech Brief

Distributed Energy Resources (DER) are a suite of onsite, grid-connected or stand-alone technology systems that can be integrated into residential, commercial, or institutional buildings and/or industrial facilities. These energy systems include distributed generation, renewable energy, and hybrid generation technologies; energy storage; thermally activated technologies that use recoverable heat for cooling, heating, or power; transmission and delivery mechanisms; control and communication technologies; and demand-side energy management tools. Such decentralized resources offer advantages over conventional grid electricity by offering end users a diversified fuel supply; higher power reliability, quality, and efficiency; lower emissions; and greater flexibility to respond to changing energy needs.

Since 1976, researchers in the Combustion Equipment Technology Program at Brookhaven National Laboratory (BNL) have been leading the development of ultra-low emissions combustion technologies that can be used in distributed generation and cooling, heating, and power (CHP) applications.

Currently, about 95 percent of all residential oil boilers use a high-pressure atomizing gun oil burner for No. 2 fuel oil. This type of burner supplies oil to the atomizing nozzle at pressures of 100 to 300 psig. A fan supplies air for combustion; a fan inlet damper regulates the air supply at the burner. A high voltage spark ignites the fuel by either constant or interrupted ignition. These burners fire into a combustion chamber in which draft is maintained. Some of the potential improvements to these types of burners are methods to improve atomization; fuel pre-heaters for cold fuel; and controlled mixing of air, fuel, and combustion products in the burner head to reduce emissions. A few other types of burners on the market are air-pressure atomizing, vaporizing burners for use with No.1 fuel oil, and rotary burners.

Brookhaven's Fan Atomized Burner for CHP Applications

Small improvements in any of these burner designs will contribute to fuel and cost savings and reduce emissions. Part of the program's research focuses on identifying alternative atomization technologies that can achieve low firing rates, two-stage firing, and modulation. The program also will develop technologies specifically for oil combustion in CHP chiller hybrid systems, where high preheated air is useful.

Technologies such as the patented Fan Atomized Burner (FAB), developed under DOE sponsorship, are being commercialized. This oil burner fires fuel at low input rates to match the smaller heating loads of well-insulated homes. It also offers improved fuel and air mixing for better performance. These features translate into a 5- to 10-percent improvement in efficiency over conventional burners, reducing NO_x emissions by 50 percent or more.

Researchers are also examining the viability of low-sulfur fuel and bio-fuels for cleaner feedstock.

Market Potential

- According to NORA, over 10 million homes are heated with oil in the United States, providing a vast market for clean advanced oil heat combustion technologies.
- Advanced oil heat technologies provide consumers with new technology options and U.S. industry with new markets.

Environmental Benefits

- The currently accepted NO_x emission level for residential oil burners is 120 parts per million (ppm). A practically achievable NO_x emission level, based on European experience, is 50-60 ppm.

Applications

According to the National Oilheat Research Alliance (NORA), over 10 million homes are heated with oil in the United States. The transmission and distribution infrastructure is most developed in the northeastern United States. "Early adopters" of distributed oil combustion technologies will most likely be commercial buildings and institutional facilities in the northeastern United States that have access to oil, but not to natural gas. Residential applications may follow.

Advanced oil heat combustion technologies are more reliable, require less maintenance, and are more resilient to power interruptions than standard technologies. More reliable systems will reduce maintenance costs for homeowners and operating costs for fuel oil marketers. Using oil-fired cogeneration systems for electric power and heating functions will also result in systems that can run independent of the power grid.

Program Goals and Activities

Under DOE's and NORA's combustion plan, BNL hopes to refine the core technology of heating oil burners. Researchers will focus on the dynamics of low NO_x flames, oil-fired cooling application development, and improved burner performance.

For further information:

Office of Power Technologies:
www.eren.doe.gov/power/

Distributed Energy Resources:
www.eren.doe.gov/der

CHP for Buildings:
www.bchp.org/home.html

Brookhaven National Laboratory:
www.bnl.gov/est/CETP.htm

Partners:

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